

**Closure/Post-Closure Plan  
for the  
Proteccion Tecnica Ecologica, Inc.  
Closure of Waste Unit Numbers 1, 2,  
3, 5, 7, 9, 10, 11, 12, 13, 16 and 17**

Submitted to:

**Proteccion Tecnica Ecologica, Inc.**  
Penuelas, Puerto Rico

Submitted by:

**OHM Remediation Services Corp.**  
Norcross, Georgia

September 30, 1994

OHM Project Number 16139

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## 1.0 INTRODUCTION

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This Closure/Post-Closure Plan has been prepared for the Protección Técnica Ecológica, Inc. (PROTECO) hazardous waste landfill (Waste Units 1, 2, 3, 5, 7, 9, 10, 11, 12, 13, 16 and 17) in Penuelas, Puerto Rico, in accordance with the Commonwealth of Puerto Rico's Regulation for the Control of Hazardous and Nonhazardous Solid Wastes, Rule 816 – Hazardous Solid Waste Landfills and U. S. Environmental Protection Agency (USEPA) 40 CFR 264.

The objectives of constructing the final landfill cover are as follows:

- Provide long-term minimization of migration of liquids through the closed landfill units;
- Function with minimum maintenance;
- Promote drainage and minimize erosion or abrasion of the cover;
- Accommodate settling and subsidence so that the cover's integrity is maintained; and
- Have a permeability less than or equal to the natural subsoils present.

This plan presents the closure and post-closure care activities. Closure of the individual waste units is discussed under separate cover in Corrective Action Management Unit (CAMU), to be submitted at a later date.

### 1.1 BACKGROUND

PROTECO is located 100 meters above sea level facing the Caribbean Sea on the southern side of Puerto Rico. The site is rugged upland valley terrain 2.3 kilometers east of Sebouruco, the closest residential community. Typical climatic conditions are arid with 32 inches of annual precipitation, 88 inches of annual pan evaporation, 79°F mean annual temperature, and predominantly easterly winds off the Caribbean Sea. The steep hills which ring the isolated site

are covered year-round with xerophilous vegetation and are inhospitable to residential, commercial, or agricultural development. Most precipitation is lost to run-off due to hard, impermeable surface soil conditions and steep slopes.

The hazardous waste units to be closed consist of drum burial (Unit Numbers 1, 2, 3 and 5), neutralization impoundment (Unit No. 7), oil lagoon (Unit No. 9), immobilization facility (Unit Nos. 10, 11 and 16), land treatment area (Unit No. 12), rainwater lagoon (Unit No. 13), and neutralization impoundment (Unit No. 17).

## 2.0 CLOSURE PLAN

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The PROTECO hazardous waste landfill will be closed by constructing a final cover over the waste units to minimize migration of liquids into the waste. The final cover will consist of the following components (in order from deepest to surface):

- Low permeability layer
- Geomembrane
- Drainage layer
- Geotextile
- Vegetative layer
- Topsoil
- Vegetation or surface armor

A gas venting system will be installed in the final cover. Final cover construction requirements are presented in the construction plans and specifications. Control of construction procedures and methods are defined in the Construction Quality Assurance Plan. Other closure documents include the Design Report, Erosion and Sediment Control Plan, Spill Prevention and Control Plan and Hydrologic Investigation.

The hazardous waste units have been located, designed and constructed to restrict contact between the hazardous materials and the groundwater or surface waters. The units liner or natural in-place soil barrier extends significantly greater than 5 feet (1.5 meters) above the historical high water table. The units are located in a rural area of Puerto Rico and therefore, are located significantly further than 500 feet (150 meters) from public or private water supply, or livestock water supply.

Diversion structures will be constructed to restrict surface water run-off from flowing onto the final cover. Post-closure activities will include surface water, groundwater and air monitoring to control pollutant migration.



Closure will be certified by an independent registered professional engineer, verifying compliance with the closure plan.

## 2.1 FINAL COVER INSTALLATION

The hazardous waste units were initially covered with compacted clay. Closure procedures will begin with the placement of additional compacted clay to a rise grade in preparation for the final cover. The grading will involve almost entirely fill placement with very little excavation and no excavation within areas of the waste units.

The low permeability layer will consist of a 2-foot (60-cm) thick layer of compacted clay, with a hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec or less, constructed over the graded waste units. This layer will have a minimum grade of 3 percent and will be below the frost penetration which is not a consideration in Puerto Rico.

A 40-mil HDPE flexible membrane liner (geomembrane) will be installed over and in direct contact with the low permeability layer by a qualified specialist contractor.

The drainage layer will consist of sand with a minimum hydraulic conductivity of  $1 \times 10^{-2}$  cm/sec or greater. This layer will not be compacted. A 4- to 6-ounce non-woven geotextile will be placed over the drainage layer as a filter to restrict the movement of soil particles into the drainage layer.

The top layer of the final cover will be a vegetation layer with a minimum thickness of 2 feet of which topsoil will comprise 6 inches. Directly over the waste units, the top of the vegetation layer will be graded at a slope ranging from 3 and 5 percent. The surface of the final cover will be protected from erosion by either vegetation or surface armor (2- to 4-inch stone). The vegetation will be a local grass indigenous to the area. This grass requires little maintenance.

## 2.2 CLOSURE SCHEDULE

PROTECO will construct the final cover over the hazardous waste units within 9 months after receiving notice from USEPA that the Closure/Post Closure Plan has been accepted. A detailed construction schedule is shown on Table 2.1.

**TABLE 2.1**  
**PROTECO HAZARDOUS WASTE UNIT CLOSURE**  
**FINAL COVER CONSTRUCTION SCHEDULE**

Task Name	Start Date	Duration	End Date	1994				1995					
				Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
MOBILIZATION	29 Sep-94	1.0 d	29 Sep-94	▲									
EXCAVATE SUB BASE	29 Sep-94	20.0 d	27 Oct-94	▲	▲								
GRADE SUB BASE	17 Oct-94	10.0 d	28 Oct-94		▲	▲							
CLAY LINER EXCAVATE, GRADE, COMP	25 Oct-94	35.0 d	14 Dec-94		▲	▲	▲						
HDPPE LINER INSTALLATION	5 Dec-94	15.0 d	23 Dec-94				▲	▲					
SAND DRAINAGE LAYER	15 Dec-94	28.0 d	28 Jan-95				▲	▲					
PIPING SYSTEM, DITCHES, CULVERTS	17 Jan-95	35.0 d	7 Mar-95					▲	▲	▲			
GEOMEMBRANE LINER INSTALLATION	2 Mar-95	9.0 d	14 Mar-95						▲	▲			
VEGETATIVE LAYER, GAS VENT SYST	13 Mar-95	50.0 d	19 May-95							▲		▲	
SURFACE ARMOR, EROSION CONTROL	12 May-95	17.0 d	8 Jun-95									▲	▲
MONITORING WELL INSTALLATION	25 May-95	8.0 d	8 Jun-95									▲	▲
SEEDING, SODDING, & MULCHING	7 Jun-95	14.0 d	28 Jun-95										▲

ASSUMPTIONS MADE FOR SCHEDULING PURPOSES MAY BE ALTERED BY QUANTITIES AVAILABLE OR NUMBER OF TRANSPORTERS



### 3.0 CLOSURE AND POST-CLOSURE

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The post-closure care period will continue for 30 years after completion of the final closure cover of the hazardous waste units. Post-closure use of the site will be designed to avoid disturbance of the final cover integrity.

The post-closure care activities will consist of the following:

- Maintaining the integrity and effectiveness of the final cover, including making repairs to the cover as necessary to correct the affects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover.
- Maintaining and operating the surface water and groundwater monitoring system.
- Maintaining and operating the gas monitoring system.

Following completion of the post-closure care period, an independent registered professional engineer will certify that the post-closure care has been completed in accordance with the post-closure plan.

#### 3.1 EROSION AND SEDIMENT CONTROL PLAN

A Construction Erosion and Sediment Control Plan has been prepared for submittal as a separate document. Erosion and sediment control has also been addressed in the construction drawings and specifications.

After construction, soil loss from the final closure cover was computed using the Universal Soil-Loss Equation. The calculated maximum soil loss for the closure waste unit area is 1 ton/acre/year. The soil loss calculations are provided in the Design Report.

### **3.2 GROUNDWATER MONITORING**

The quality of the groundwater at the facility will be monitored in accordance with 40 CFR 264 Subpart F – Releases From Solid Waste Management Units. A hydrologic investigation was performed to determine if the limestone aquifer is hydraulically connected with the suspected alluvial and/or principal water-bearing zones. No connection was found. The hydrologic investigation report is presented under separate cover. After this report is reviewed by the USEPA, work and discussions will continue with the USEPA to develop a groundwater monitoring plan.

### **3.3 SURFACE WATER MONITORING**

The quality of the surface water at the facility will be monitored in the same manner as groundwater. Water samples will be collected from the retention basin to be constructed at the south end of the property as part of the closure plan. These samples will be analyzed at the frequencies and for the parameters defined for the groundwater monitoring. This data will be used to identify if significant waste or constituents has the potential to leave the site by main discharge routes.

### **3.4 AIR MONITORING**

Air monitoring will be implemented at the same frequency as the groundwater to detect airborne contaminants at the site property line and within the area of the facility. Monitoring will be conducted for the detection of volatile organic compounds, dust and hydrogen sulfide. Should allowable limits be exceeded, corrective action will be taken to protect human health and the environment. Results of the air monitoring will be retained in the site files and will be provided to the appropriate regulatory agencies.

### **3.5 ACCESS CONTROL**

The site of the subject hazardous waste units is also an active industrial landfill and access during the closure and post-closure periods will be the same as

presently exists for the operating landfill. Specifically, all vehicles and personnel gain access to the site through the main access gate in front of the operations building.

### 3.6 INSPECTIONS

Thorough inspections of the site will be conducted on a regular basis (at a minimum quarterly) by PROTECO personnel for the duration of the post-closure care period. The inspections will determine the requirements for additional maintenance or other corrective measures needed to prevent deterioration of the closure system.

Table 3.1 presents the schedule for inspecting the final cover, surface water and groundwater monitoring points, security devices, and stormwater control. Each inspection will be documented and will include the following information:

- Date and time of inspection
- Name of inspector
- Observations
- Corrective measures (if any)

### 3.7 SITE MAINTENANCE

The integrity of the final cover system for the hazardous waste units will be maintained through the post-closure care period through comprehensive inspection and maintenance. The grass vegetative cover over portions of the site (surface armor over some portions) will be maintained by mowing on a regular schedule. The mowing schedule should prevent the growth of weeds or rooting bushes that may damage the final cover. Areas devoid of grass to 75 percent or less will be reseeded and an application of fertilizer applied. Any significant depressions or erosion areas will be promptly repaired.



Table 3.1  
**PROTECO Hazardous Waste Unit Closure**  
**Post-Closure Maintenance and Inspection Schedule**

Area/ Equipment	Specific Item	Types of Problems	Frequency of Inspection
Final Cover	Vegetation	Bare or dead areas	Quarterly
	Integrity	Erosion of soil, deterioration of vegetation, ponding, rodent holes	Quarterly
	Berms	Erosion, cracking, settling, ponding, leaks	Quarterly
	Drainage channels, culverts, pipes, inlet structures, detention basins, risers, and benches	Obstruction of flow, bank erosion, ponding, vegetation stress, scour an inlet or outlet	
	Discharge pipes and connections to header pipe (cover drainage)	Cracking, signs of leaks, wet spots, other signs of deterioration	Quarterly/after major storm event
Groundwater Monitoring Wells	Locks, foundation concrete, well	Tampering, rust, cracking, pitting, flaking, tempering, degradation of pipe	When sampled
Security Devices	Facility gates	Corrosion, damage to chain-link fence, locks broke	Quarterly
	Locks	Tampering, rust	Quarterly
	Facility fences	Corrosion, damage to chain-link fence	Quarterly
	Warning signs	Missing or damaged	Quarterly
General Site	All areas	Litter, debris	Quarterly

Repair will be made when necessary to the stormwater control system. Damaged dikes will be repaired or replaced. Sedimentation basins and drainage channels will be kept clear; silt and weeds will be removed.

Evaluation of the security devices will be made during each inspection. Fence, gates and locks will be maintained and repaired as necessary.

Benchmarks used as references for the site survey will be maintained throughout the post-closure period.

## 4.0 CONTACT OFFICES

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During the final closure and post-closure period, PROTECO can be contacted through:

- Dr. Jorge Fernandez  
PROTECO  
P. O. Box 71331  
San Juan, PR 00936-8431  
(809) 272-8411
- Mr. Rene Rodriguez  
PROTECO  
Carr. 385 KM. 3.5  
Penuelas, PR 00624  
(809) 836-2058



**APPENDIX A**

**COST ESTIMATE DETAILS**

**TABLE A-1**

**Proteco Hazardous Waste Unit Closure  
Closure and Post-Closure Cost Estimate**

■ Closure Cover Costs	\$1,345,000.00
Final cover and drainage construction	
■ Post-Closure Costs	<u>\$138,000.00</u>
Site maintenance and inspection	
<b>Total Closure and Post-Closure Cost</b>	<b><u>\$1,482,000.00</u></b>

- (1) Detailed cost analysis presented on worksheets.
- (2) Cost estimate does not include groundwater monitoring well installation, surface water, groundwater, and air monitoring throughout the 30 year post-closure period.

## WORKSHEET A

### Proteco Hazardous Waste Unit Closure Final Cover Construcion Cost Estimate

<u>ITEM</u>	<u>UNIT</u>	<u>QUANTITY</u>	<u>UNIT COST</u>	<u>TOTAL</u>
Soil for Sub-base Grade - includes excavation, backfill, and compaction of onsite material*	C.Y. Fill	20,845	\$6.00/yd	\$125,070.00
Clay - Soil Liner - includes excavation, backfill, and compaction of onsite material*	C.Y.	12,965	18.80/yd	243,742.00
40-mil HDPE Liner	S.Y.	19,447	6.00	116,682.00
Sand for Drainage Layer	C.Y.	6,483	16.50	106,969.00
Geotextile Filter Fabric	S.Y.	19,447	1.35	26,254.50
Drainage Net	S.Y.	1,500	5.00	7,500.00
Soil for Vegetative Cover - includes excavation, backfill, and compaction of onsite material (this includes all soil material other than that required for the sub-base, clay liner, and sand drainage layer)*	C.Y. Fill	73,816	5.00	295,264.00
Top soil	C.Y.	1,656	18.80	31,132.80
Seeding and Sodding	S.Y.	9,933	1.05/sy	10,430.00
Surface Armor (2"-4" crushed stone)	C.Y.	1,586	12.50/yd	19,825.00

\*Materials will be readily available on-site.

Detention Basin Construction includes excavation, backfill, compaction, and testing of onsite material to complete detention basin	L.S.			17,500.00
Detention Basin Spillway	L.S.			9,200.00
Sediment Basin includes excavation, backfill, compaction, and testing of onsite material to construct detention basin	L.S.			72,000.00
Sediment Basin Spillway	L.S.			8,700.00
Drainage Ditch Construction - 4' width	L.F.	3,300	7.50	27,225.00
Drainage Ditch Construction - 15' width	L.F.	650	4.50	3,412.50
Trenching and Backfill for Culverts	L.S.			9,200.00
Anchor Trench	L.F.	1,800	4.50/lf	9,450.00
Erosion Control Silt Fence, Straw Barrier	L.F.	3,500	1.75	6,125.00
4" HDPE Pipe	L.F.	600	3.75/ft	2,250.00
4" HDPE 180° Elbows	Each	20	144.50	2,890.00
4" HDPE Tees	Each	20	113.75	2,275.00
4" HDPE End Caps	Each	40	35.02	1,400.00
Welds	Each	110	15.00	1,650.00
18" CMP	L.F.	124	9.20	1,140.80
24" CMP - Perforated	L.F.	14	10.15	142.10

36" CMP	L.F.	302	23.97	7,238.94
42" CMP	L.F.	60	31.85	1,911.00
36" Trash Rack	Each	1	472.00	472.00
R-2 Rip-rap	C.Y.	210	12.50	2,625.00
R-3 Rip-rap	C.Y.	280	12.50	3,500.00
R-4 Rip-rap	C.Y.	1,680	12.50	21,000.00
R-5 Rip-rap	C.Y.	700	12.50	1,050.00
R- 6 Rip-rap	C.Y.	140	12.50	1,750.00
R-7 Rip-rap	C.Y.	140	12.50	1,750.00
No. 57 Stone	C.Y.	200	12.50	2,500.00
Concrete (for headwalls and riser pipe) #3, #4, #6 Steel Rebar	L.F.	2 Each	14,773.00	29,546.00
Freight for Piping	Each	2	7,200.00	14,500.00
On-Site Survey of lifts and density as specified, including equipment = 1 Technician on-site \$45/hr at 60 hrs at 36 weeks				<u>100,000.00</u>
TOTAL				<u>\$1,345,272.64</u>



## WORKSHEET B

### Proteco Hazardous Waste Unit Closure Post-Closure Cost Site Maintenance and Inspection

- Sod to -establish vegetation on the surface of the final cover and any other exposed soil surfaces.

Assume that 5% of 4 acres per year will be re-sodded

$$0.2 \text{ acre} \times \$5,080/\text{acre per year} \times 30 \text{ years} = \$30,500.00$$

- Routine Inspection and Reporting

Assume quarterly inspections will be made by PROTECO personnel. Visual examination of the site surface conditions will be made to identify areas in need of repair.

$$4 \text{ days/year} \times \$200/\text{day} \times 30 \text{ years} = \$24,000.00$$

- Repair of Final Cover

Assume \$500/acre per year for the first 5 years and \$250/acre per year for the remaining 25 years.

$$4 \text{ acres} \times (\$500/\text{year} \times 5 \text{ years} + \$250/\text{year} \times 25 \text{ years}) = \$35,000.00$$

- Repair of Surface Water Control Structures

Assume \$50/acre per year for the first 5 years and \$25/acre per year for the remaining 25 years. Base on a 4-acre site.

$$4 \text{ acres} (\$50/\text{year} \times 5 \text{ years} + \$25/\text{year} \times 25 \text{ years}) = \$3,500.00$$

- Ditch and Sedimentation Basin Cleaning

Soil accumulation in ditches and sedimentation basin will be removed on a routine basis. The estimated cost for this work is \$4,000 per year for the first 5 years and \$1,000 per year for the next 25 years.

$$5 \text{ years} \times \$4,000/\text{year} + 25 \text{ years} \times \$1,000/\text{year} = \underline{\underline{\$45,000.00}}$$

**Total Cost for Site Maintenance and Inspection**

**\$138,000.00**

## **WORKSHEET C**

### **Proteco Hazardous Waste Unit Closure Resource Breakdown**

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■ Personnel	\$457,411.00
■ Equipment	\$260,400.00
■ Materials	\$413,695.64
■ Subcontractors	<u>\$213,766.00</u>
<b>Total Resource Breakdown</b>	<b><u>\$1,345,272.64</u></b>

## CLARIFICATIONS AND ASSUMPTIONS

- All heavy equipment, labor, equipment operators, and maintenance will be provided by Proteco (i.e. listed below\*)
- OHM assumes the cap area does not require grubbing or reworking. The landfill area will be able to have the liner layers installed.
- Water to be utilized for hydrating the clay cap layer to the over optimum moisture specification will be supplied by Proteco. Dispersion of water onto clay liner will be provided by the Proteco semi-water tanker.
- Diesel fuel, oil, grease, replacement parts and maintenance labor will be provided by Proteco.
- On-site office requirements, such as electricity, phone, restrooms, and break area will be supplied on site by Proteco for subcontractor personnel.
- Shipping of geotextile material, liners and any local material that requires additional freight cost or tariffs will be charged to Proteco at a cost plus basis per service agreement for handling fees.
- \*Proteco will dedicate approximately one-half of their equipment resources to grading and landfill capping procedures:
  - (3) 35cyd semi-tractor/transfer axle dump trailer
  - (1) Off-road dump truck Eucke
  - (1) Pan - Drop belly scraper
  - (1 or 2) Bulldozers as required by D6, D7, or D8
  - (1) Motor grader, semi-tractor/water wagon trailer
  - (1) Trackhoe
  - (1) Smooth drum roller
  - (1) Lambs foot roller
- Stone, rock, sand, and clay material including below sub-grade filler and vegetative layer fill material will be estimated as bid from suppliers. Should quantities or quality discontinue, Proteco will be billed at supplied material rate at cost plus agreement rates.
- All storms, hurricanes, rain days, force majures, or any acts of God, will be fully negotiated by OHM and Proteco for project path alterations and subcontractor durations.
- These cost estimates are for documented design of the landfill capping project. Any change by Proteco or Regulatory Agencies will be subsequent project

additions. All work outside the estimated scope of work will be incorporated into the current project activities only after a change order has been negotiated and finalized.

- All DOT violations will be paid by trucking contractor and the off-site activities will be governed by transportation law of the state.
- All utilities will be marked in advance including any utility poles that may need to be relocated to provide space for vegetative layer over cap.
- All excavation operations will be supervised by a designated spotter such as a Safety Officer, Project Engineer, Site Supervisor or equivalent. It is assumed that these operations will not require level C PPE or above protection for excavation activities into subsurface material. If necessary, unit rate PPE will be supplied accordingly.
- Soil for sub-base grade, and vegetative cover will be borrow material from on-site excavation/grading operations.
- Excavation operations assume 1000+ yards of material to be transported from borrow pit on-site to landfill cap areas on-site.
- Off-site construction materials availability is assumed at 300 yards delivered per day for sand and top soil. Stock pile operations will be coordinated for minimum down time of equipment operations.